Analysis of Multi Level Car Parking Building Using Etabs

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***Abstract*— Analysis of multilevel car parking facility building is basically a R.C.C framed structure comprising of One Basement + Ground floor + Seven Upper Floor and Terrace only. All RCC Structures elements shall be designed according to Limit State Method as specified in IS: 456 – 2000. Steel structures shall be designed as per IS: 800-2007, based on preliminary analysis. A three-dimensional structural analysis is employed to obtain stress resultants and deflections. Standard finite element software, namely ETABS was employed to analysis and design the structure.**

***Index Terms*— Multi Level Car Parking, Etabs Software**

I. INTRODUCTION

India was rapidly growing in population, as well as a lack of town planning in road accessibility, in small town to metropolitan areas. Due to road space multi-level parking is preferred. Reduce traffic congestion, provide road safety and provide convenience for traffic free vehicle movements. It can also reduce waiting time in road. Multilevel car parking is an important aspect of urban planning and development for considering future urban planning.

II. METHODOLOGY

- Planning of multi-level car parking floor plan, through literature review
- Drafting a floor plan in AutoCAD software
- Analysis the drafted floor plan in Etabs
- Discuss the analyzed model from Etabs

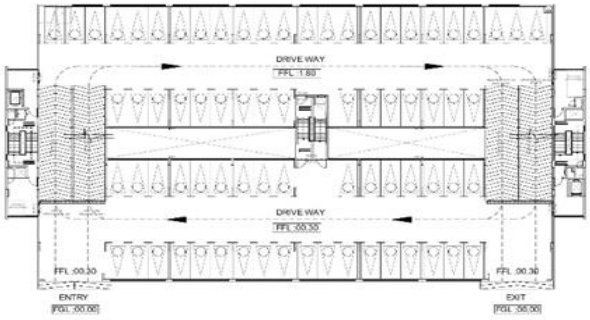
III. MODELLING

3.1 Planning

Plan of basement, ground, typical floor parking area, lift and fire sump consider (69mx36m)

Floor schedule with dimensions of the building

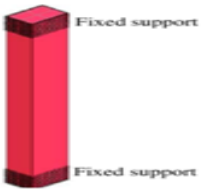
FLOOR	LENGTH (M)	BREATH (M)	HEIGHT (M)
Basement	69	32	3.25
Ground	69	32	3
First	69	32	3
Second	69	32	3
Third	69	32	3
Fourth	69	32	3
Fifth	69	32	3
Sixth	69	32	3
Seventh	69	32	3
Terrace	69	32	3
Head room	4	20	3.25



3.1 Floor Plan

3.2 Support conditions

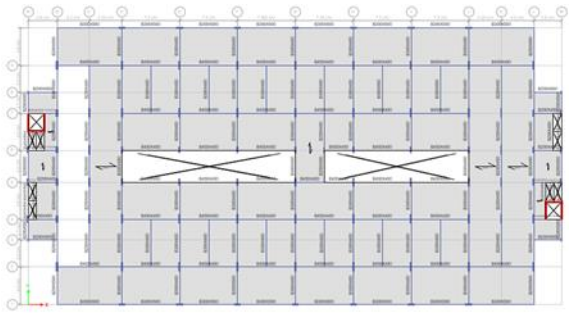
All columns are fixed support conditions



3.3 Structural Elements considered for Etabs model

Structural Members	Dimensions (mm)
Column	200x450, 200x750, 200x1200 300x900, 300x1200,
Beam	200x450, 200x600 300x450, 300x600 450x450
Slab	125mm, 150mm, 175mm One-way, Two-way slab
Staircase	175mm Thickness
Ramp	200mm Thickness one way slab

4.1 Framing Plan (Beam, Column Sizes)



3.4 Loading Conditions

Dead Load: This load case comprises of Self weight of all the frame and shell elements modelled into the structure.

Unit weight of reinforced cement concrete	25 kN/m^3
Unit weight of plain cement concrete	24 kN/m^3
Unit weight of Solid block (with plaster)	22 kN/m^3
Unit weight of steel	78.5 kN/m^3
Unit weight of cement mortar/plaster	22 kN/m^3
Filling material of sunken floors	7.85 kN/m^3
Water load	10 kN/m^3
Floor finishes	2.4 kN/m^3

Weight of materials shall be calculated based on unit weights given in IS: 875-PART 1.

Superimposed/Live Load: This load Case comprises of self-weight of walls, floor finishes, partitions, Ceiling hung loads, waterproofing, brick jelly lime concrete and PCC in toilet areas, machinery weights in the plant room and weight of landscaping.

Live load in the floor areas are considered

Parking space	3.00 kN/m^2
Toilets	2.00 kN/m^2
Stairs, corridors and balconies	4.00 kN/m^2
Terrace	1.50 kN/m^2
Staircase headroom & chejja	0.75 kN/m^2

As per IS: 875-PART 2.

Wind Load: Wind loads and pressures are calculated based on the static design wind pressure. This pressure has been considered fond applied to the model at the diaphragm centers.

Basic wind speed (V_b)	33 m/sec
(If design life of structure is taken as 50 years) Risk co-efficient k_1	1
Terrain roughness and height factor k_2	1.095
Category 2, & class B	
Topography factor k_3	1
Importance factor K_4	1

Wind loads for design of structures shall be based on the design wind speeds based on IS: 875- PART 3.)

Seismic Load: Static analyses for earthquake forces in both directions are carried out as per Code. The base shear is calculated as per the codal provisions IS:1893-2016

Zone (Assumed)	II
Zone factor	0.1
Importance factor	1
Response reduction factor(R)	3
Horizontal seismic co-efficient (Ah)	$\frac{Z \times I \times Sa}{2 \times R \times g}$

3.5 Load Combinations: These loading combinations are considered in the analysis of framed structures for buildings information as applied to the model.

Load Combination	Limit State of Collapse			Limit state of Serviceability		
	DL	LL	WL/ EL	DL	LL	WL/ EL
DL+LL	1.5	1.5	---	1.0	1.0	---
DL+WL	1.5 or 0.9	---	1.5	1.0	---	1.0
DL+/-EL	1.5 or 0.9	---	1.5	1.0	---	1.5
DL+LL+/-WL	1.2	1.2	1.2	1.0	0.8	0.8
DL+LL+/-EL	1.2	1.2	1.2	1.0	0.8	0.8

Wind and Earthquake load shall be considered for both X and Y direction.

Notations

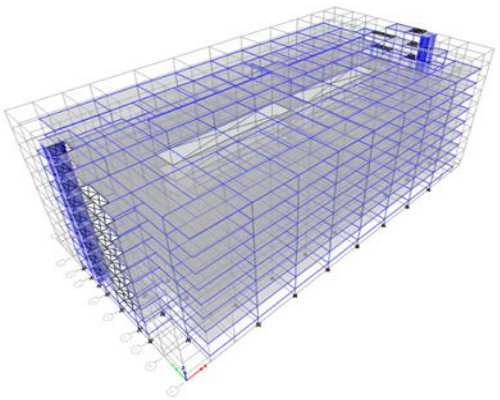
DL → Dead Load

LL → Live Load

WL→ Wind Load (Either X or Y Direction)

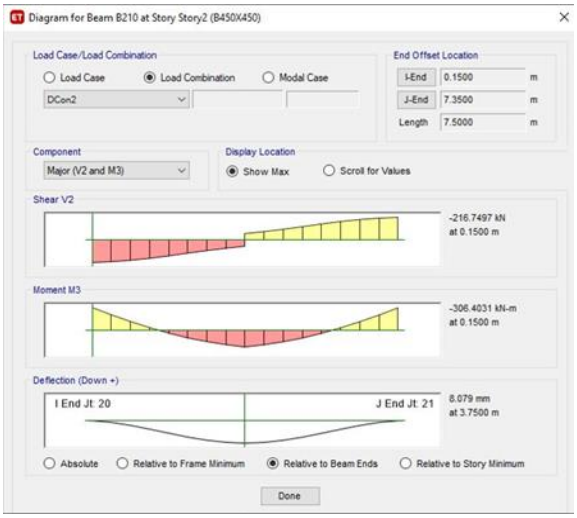
EL → Earthquake Load (Either X or Y Direction)

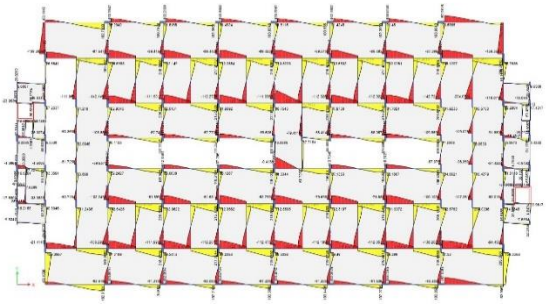
IV. ANALYSIS THE MODEL



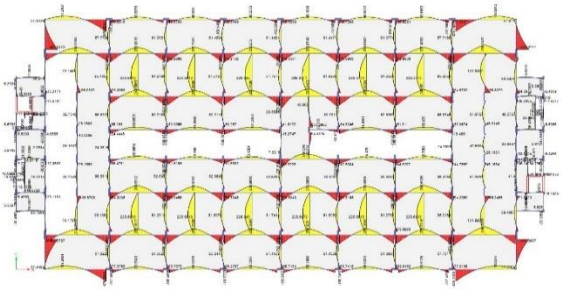
Model view of all floor levels

4.1) Shear Force Analysis (Plan view)

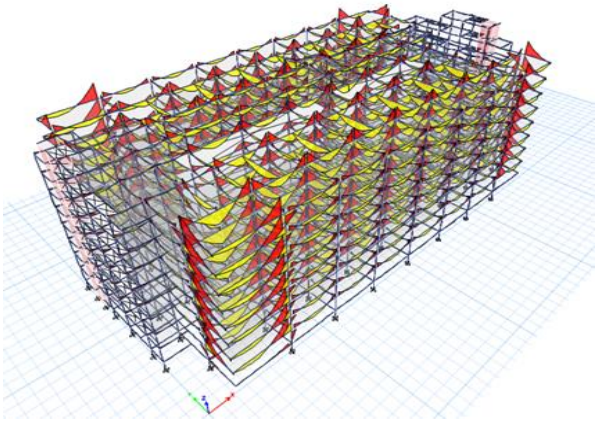




4.2) Bending Moment Analysis



Bending Moment Reactions - plan



Bending Moment Reactions – All floor section

4.3) Maximum Reaction for Shear and Bending Moment and displacement

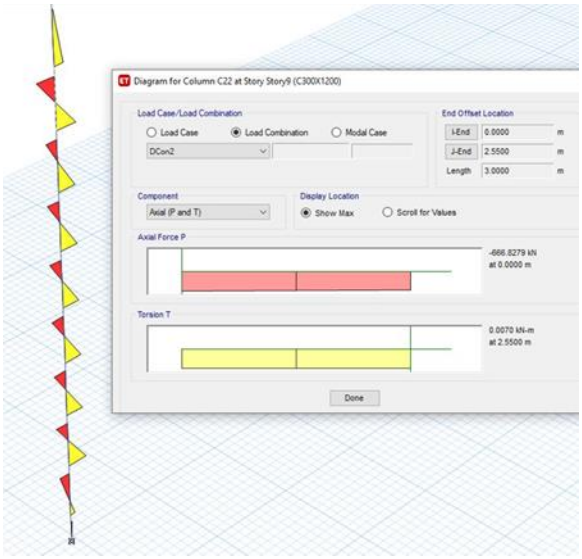
a) For Beam 450x450mm maximum reaction founded

- Shear (V)=-261.75 kN at 0.15m
- Moment (M)=-306.40 kN-m at 0.15m
- Deflection(down)=8.079mm at 3.7m mid span

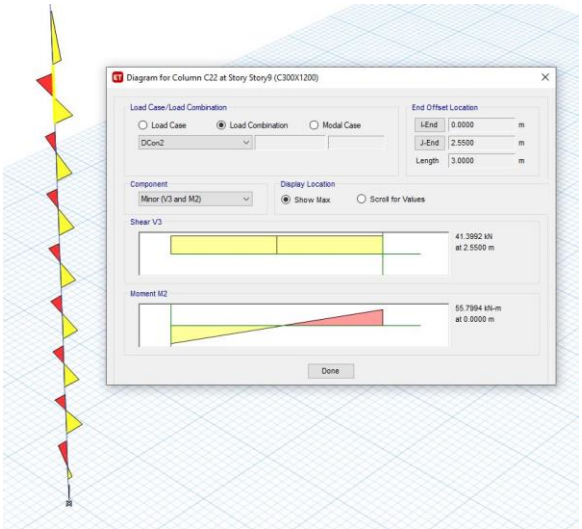
Beam – 450x450 Shear Force and Bending Moment

b) For Column 300x1200mm reaction founded

- Axial Force (P)=-666.82 kN
- Torsion (T)=0.0070 kN
- Shear (V)=41.40 kN at 2.55m
- Moment (M)=55.80 kN-m at 0.0m



Column – 300x1200 Axial Force and Torsion



Column – 300x1200 Shear Force and Bending Moment

V. CONCLUSION

1. During this project work I have learned Etabs software
2. There is no error in analysis in Etabs Model
3. Analysis of the structure is safe for the loading consideration as per IS Code.
4. Maximum values of sheer force, bending moments and displacements were determined
5. All Structural Elements are safe and economical
6. The proposed multi-level car parking building facility of accommodation 685 cars.

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